CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus for switching an optical signal, the apparatus comprising:

a substrate;

a movable microstructure formed by a semiconductor process on the substrate, the movable microstructure being suspended at a distance from the substrate and being adapted to move relative to the substrate;

an actuator to cause the movable microstructure to move from a first position to a second position relative to the substrate;

a mirrorless light-guiding structure mounted to the movable microstructure such that the mirrorless light-guiding structure moves with the movable microstructure, the mirrorless light-guiding structure including a first set of optical paths and a second set of optical paths such that when the movable microstructure is in the first position, the optical signal travels along the first set of optical paths in the light-guiding structure, and when the movable microstructure is in the second position, the optical signal travels along the second set of optical paths in the mirrorless light-guiding structure; and

an input stationary waveguide coupled to the substrate and positioned to transmit the optical signal over a gap between the input stationary waveguide and the first set of optical paths in the mirrorless light-guiding structure, wherein the gap is oriented at an oblique angle to the input stationary waveguide and to the first set of optical paths of the mirrorless light-guiding structure.

2. The apparatus of claim 1, wherein the first set of optical paths has a large radius of curvature which gradually changes the direction of the optical signal.

3. The apparatus of claim 1, further comprising a notch in a first edge portion of the movable microstructure, the first edge portion extending in a Y direction, the microstructure having a second edge portion which extends in an X direction, the X and Y directions being substantially perpendicular to each other, the notch having a third edge portion and a fourth edge portion, wherein the fourth edge portion extends substantially

parallel to the X direction, and wherein the optical signal enters the first set of optical paths at the fourth edge portion of the notch, wherein the gap is located adjacent to the fourth edge portion of the notch.

4. The apparatus of claim 3 wherein the optical signal exits the first set of optical paths at the second edge portion of the movable microstructure.

5. The apparatus of claim 3, wherein the movable microstructure is adapted to move in the X direction relative to the substrate.

6. The apparatus of claim 1, wherein the gap is an air gap.

7. The apparatus of claim 1, wherein the mirrorless light-guiding structure includes a plurality of waveguides.

8. The apparatus of claim 7, wherein the plurality of waveguides include a first waveguide to provide the first set of optical paths and a second waveguide to provide the second set of optical paths, wherein when the movable microstructure is in the first position, the first waveguide is aligned to receive the optical signal and when the movable microstructure is in the second position, the second waveguide is aligned to receive the optical signal.

9. The apparatus of claim 1, further comprising an output stationary waveguide coupled to the substrate and positioned to receive the optical signal from the first or second sets of optical paths over a second gap between the substrate and the movable microstructure, wherein the second gap is oriented at an oblique angle to the output stationary waveguide and to the first set of optical paths of the mirrorless light-guiding structure.

10. The apparatus of claim 1, wherein the width of the gap is optimize to allow both movement of the movable microstructure and transmission of the optical signal.

11. An optical switching system comprising: √

(a) an input port comprising a stationary input light guiding structure adapted to receive a first optical signal, the stationary input light guiding structure being aligned to transmit the first optical signal to one of a plurality of optical switching devices;

(b) a plurality of output ports; and

(c) the plurality of optical switching devices coupled to the input port and adapted to receive the first optical signal from the stationary input light guiding structure and switch the first optical signal to one of the plurality of output ports, each optical switching device comprising:

(i) a substrate;

(ii) a movable microstructure formed by a semiconductor process on the substrate, the movable microstructure being suspended at a distance from the substrate and being adapted to move relative to the substrate;

(iii) an actuator adapted to cause the movable microstructure to move from a first position to a second position relative to the substrate;

(iv) a light-guiding structure mounted to the movable microstructure such that the light-guiding structure moves with the movable microstructure, wherein the light-guiding structure comprises a first set of optical paths and a second set of optical paths, such that when the movable microstructure is in a first position, the first optical signal travels along the first set of optical paths in the light-guiding structure, and when the movable microstructure is in a second position, the first optical signal travels along the second set of optical paths in the light-guiding structure; and

(v) a gap formed between and defined by a first face of the stationary input light guiding structure and a second face of the first set of optical paths of the movable microstructure;

wherein the gap causes the first optical signal to exit the stationary input light guiding structure at an oblique angle and to enter the first set of optical paths at an oblique angle.

12. The optical switching system of claim 11, further comprising a stationary output light guiding structure aligned to receive the first optical signal from one of the plurality of optical switching devices over a second gap located between the output port and the movable microstructure, wherein the second gap is oriented at an oblique angle to the first set of optical paths and to the stationary output light guiding structure.

13. The optical switching system of claim 11, further comprising a notch in a first edge portion of the movable microstructure, the first edge portion extending in a Y direction, the microstructure having a second edge portion which extends in an X direction, the X and Y directions being substantially perpendicular to each other, the notch having a third edge portion and a fourth edge portion, wherein the fourth edge portion extends substantially parallel to the X direction, and wherein the first optical signal enters the first set of optical paths at the fourth edge portion of the notch, wherein the gap is located adjacent to the fourth edge portion of the notch.

14. The optical switching system of claim 11, wherein the first set of optical paths has a large radius of curvature which gradually changes the direction of the first optical signal.

15. The optical switching system of claim 13, wherein the first optical signal exits the first set of optical paths at the second edge portion of the movable microstructure.

16. The optical switching system of claim 11, wherein the gap is an air gap.

17. The optical switching system of claim 11, wherein the width of the gap is optimized to allow both movement of the movable microstructure and transmission of the first optical signal.